COMPARISON BETWEEN CARBOXYMETHYL CELLULOSE (CMC) AND PALM OIL FUEL ASH (POFA) AS ALTERNATIVES IN FLUID LOSS AGENT

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ABSTRACT

In drilling operation, fluid loss can be defined when high hydro static pressure compared to formation pressure that caused the mud filtrate lost to the permeable formation. Fluid loss agent are used to control the process and avoid potential reservoir damage. Drilling fluid formulation has become important in the effort of obtaining right formulated drilling fluid. The purpose of this study is to investigate the potential of Palm Oil Fuel Ash (POFA) additive in water-based drilling fluid as fluid loss agent. Performance of WBM with POFA additive will be compared to basic mud and WBM with Carboxymethyl Cellulose (CMC) additive as commercial fluid loss agent. There are 10 samples prepared in this project including 1 basic WBM sample, 3 different concentration of POFA mud sample, 3 different concentration of CMC mud sample and 3 different concentration of combined mud sample with 50% CMC 50% POFA additive. The 3 concentrations were tested are 0.5 g, 1.0 g and 1.5 g. The rheological properties;plastic viscosity, yield point and gel strength of all water-based mud samples in this project were analyzed at 75°F and 250 °F temperature. The filtration were tested for both Low Pressure Low Temperature (LPLT) at 75°F with 100 psi pressure and High Pressure High Temperature (HPHT) at 250°F with 500 psi to study the fluid loss property on both conditions. Rheology properties in for 75°F temperature showed that POFA has good plastic viscosity within the range but not good in yield point and gel strength reading compared to CMC. For high temperature, POFA showed degradation in the rheological properties. Based on both fluid loss test in LPLT and HPHT, POFA showed recommended result for LPLT condition but it reduces in performance with higher fluid loss at HPHT condition.

ABSTRAK

Dalam operasi penggerudian, kehilangan bendalir boleh ditakrifkan apabila tekanan statik hidro tinggi berbanding dengan tekanan pembentukan yang mengakibatkan penapisan lumpur hilang kepada pembentukan yang telap. Agen kehilangan bendalir digunakan untuk mengawal proses dan mengelakkan potensi kerosakan reserbor. Rumusan bendalir penggerudian telah menjadi penting dalam usaha mendapatkan bendalir penggerudian yang dirumuskan dengan betul. Tujuan kajian ini adalah untuk menyiasat potensi abu minyak kelapa sawit (POFA) dalam bendalir penggerudian berasaskan air sebagai agen kehilangan bendalir. Prestasi lumpur berasaskan air dengan bahan tambah POFA akan dibandingkan dengan lumpur asas dan lumpur berasaskan air dengan Carboxymethyl Cellulose (CMC) aditif sebagai agen kehilangan bendalir komersil. Terdapat 10 sampel yang disediakan dalam projek ini termasuk 1 sampel lumpur berasaskan air, 3 sampel berbeza kepekatan POFA lumpur, 3 sampel berbeza kepekatan lumpur CMC dan 3 sampel berbeza kepekatan untuk gabungan lumpur dengan 50% CMC 50% POFA aditif. 3 kepekatan diuji adalah 0.5 g, 1.0 g dan 1.5 g. Ciri rheologi seperti kelikatan plastik, titik hasil dan kekuatan gel semua sampel lumpur berasaskan air dalam projek ini dianalisis pada 75 ° F dan suhu 250 ° F. Penapisan telah diuji untuk kedua-dua suhu rendah tekanan rendah (LPLT) pada 75 ° F dengan tekanan 100 psi dan suhu tinggi tekanan tinggi (HPHT) pada 250 ° F dengan 500 psi untuk mengkaji harta bendalir dalam kedua-dua keadaan. Sifat reologi dalam suhu 75°F menunjukkan bahawa POFA mempunyai kelikatan plastik dalam julat yang baik tetapi tidak baik dalam titik hasil dan bacaan kekuatan gel berbanding CMC. Untuk suhu tinggi, POFA menunjukkan kemerosotan dalam sifat reologi. Berdasarkan kedua-dua ujian kehilangan bendalir dalam LPLT dan HPHT, POFA menunjukkan keputusan yang disyorkan untuk keadaan LPLT tetapi ia mengurangkan prestasi dengan kehilangan bendalir yang lebih tinggi pada keadaan HPHT.

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CHAPTER 1

INTRODUCTION

1.1 Study Background

Additive in drilling fluid is important in the formulation as it will react with the formation in the well bore that improves the rheological properties of the bentonite and less harm to the environment. Fluid loss is the most common encountered problem in most of the drilling operation, the circulation rate and differential pressure between circulating fluid and well increase, it becomes more significant (Iscan & Kok , 2007). Fluid loss should be avoided as the cost to treat the well will less benefit the operation.

CMC is a white-to-almost-white powder that is nontoxic, biodegradable, and odorless, and does not ferment under normal condition use (Esmaelirad et al., 2016). CMC acts as an additive in drilling mud to obtain thixotropic behavior and fluid loss control. Formulating fracturing fluids also shows the importance of CMC in benefiting polymer character to be crosslinker, cellulose derivative and because of its good rheological characteristics and ecological consideration. CMC also has been used widely in different industries as food industries, pharmaceutical, paper, and cosmetic (Asef & Roshan 2010).

Palm Oil Fuel Ash (POFA) obtained from palm oil production industries after the process of burning the palm oil to be ashes. It is widely used as geopolymer in construction industry as binder for concrete as many researchers found that POFA can be used to develop sustainable construction material (Liu et al., 2014). To reduce the production cost of drilling fluid, POFA is seen to be used to utilize the formulation of drilling fluid as fluid loss agent.

This study focused in drilling fluid additive using Palm Oil Fuel Ash (POFA) performance compared to existing approach using CMC for drilling fluid as fluid loss agent. Additives that are used in drilling fluid are vary depending on the type of drilling fluid. Among type of drilling fluids are non-dispersed polymer, potassium polymer, saturated salt, dispersed drilling fluids, air foam drilling fluid, oil based drilling fluid and salt water drilling fluids (Zhang et al., 2001).

1.2 Problem statement

Malaysia has become the second larger palm oil producer for the entire world (Liu et al., 2014). The growth and development of country increased by year as palm oil production become among major contributor following the economic growth and demand. The management of output and waste from the palm oil production attracted the attention from various bodies and individual to reuse or improve without any means to be wasted. Increase in palm oil waste requires a large area of land for the waste to be treated thus reduce area for other potential and further planning for country economic and industrial usage.

Previous approach in palm oil industry proved that the wastage were widely used as fertilizers, feed stock and sand conditioner (Soh et al., 2013). In addition to that, based on thermochemical showed that palm oil waste is converted through liquefaction process enhanced the waste to be used for beneficial products (Awalludin et al., 2015). This process has gained the attention to improve the palm oil waste because of the simplicity to produce solvents and biomass product. However, all approaches taken in need of burning the palm oil waste effected the environment. Even after being utilized, there is still large amount of palm oil waste occupied the land area.

As there are many effort done to utilize palm oil waste, oil and gas industry is taking an initiative to improved palm oil waste management. This research focus on Palm Oil Fuel Ash (POFA) potential as drilling fluids additive as compared to Carboxymethyl Cellulose (CMC) that has been used widely that support the technical specification of drilling fluid as fluid loss agent.

1.3 Objectives

Throughout this study, there are several goals to be achieved. the main objective in this project including:-

i. To compare industrial fluid loss agent Carboxymethyl Cellulose (CMC) and Palm Oil Fuel Ash (POFA) agriculture based as drilling fluid additives

ii. To study rheological properties of POFA in WBM

1.4 Scope of study

In completing the project, there are scopes had been focused to achieve the objective. The scope mainly narrowed to the study of WBM, POFA and CMC as fluid loss agent. The rheological studies and fluid loss performance for all mud sample were tested. The scopes are:

i. Rheology study of CMC mud sample, POFA mud sample and combined mud sample with 3 concentrations which are 0.5 g, 1.0 g and 1.5 g.

ii. Fluid loss test for Low Pressure Low Temperature (LPLT) and High Pressure High Temperature (HPHT) for all mud sample.

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